

CLAIMS

1. A method for correcting transmit power of a radio device
2 having a plurality of predetermined calibration values and a reference
voltage signal, the radio device transmitting and receiving on a plurality
4 of frequencies, each frequency having a frequency index, the method
comprising the steps of:
6 receiving a first signal having a first gain, a first frequency of the
plurality of frequencies, and the first frequency's associated frequency
8 index;
determining a receive power value of the first signal;
10 generating an automatic gain control setpoint in response to the
receive power value and the reference voltage signal;
12 selecting a first predetermined calibration value in response to the
automatic gain control setpoint and the first frequency index;
14 adjusting the first gain in response to the first calibration value;
transmitting a second signal having a second gain and a second
16 frequency of the plurality of frequencies, the second frequency having a
second frequency index;
18 determining a transmit power value of the second signal;
generating a second calibration value in response to the automatic
20 gain control setpoint, the second frequency index, and the transmit power
value; and
22 adjusting the second gain in response to the second calibration
value.
2. The method of claim 1 and further including the steps of
2 digitizing the receive power value before generating the automatic gain
control setpoint and converting the first predetermined calibration value
4 to an analog value before adjusting the first gain.
3. A radio having a transmit power calibration capability, the
2 radio transmitting and receiving signals having a plurality of
frequencies, each frequency having a frequency index, the radio
4 transmitting signals through a variable gain, transmit amplifier having
a control input and receiving signals through a variable gain, receive
6 amplifier having a control input, the radio comprising:
a power detector, coupled to the receive amplifier, for generating a
8 first power value from a received signal having a first frequency;

an integrator, coupled to the power detector, for generating an automatic gain control setpoint from the power value;

a receive linearizer, coupled to the integrator and the receive amplifier, for generating a receive calibration value in response to the automatic gain control setpoint and a first frequency index corresponding to the frequency of the received signal, the receive calibration value being coupled to the receive amplifier control input and adjusting the gain of the receive amplifier;

a second power detector, coupled to the transmit amplifier, for generating a second power value from a transmitted signal having a second frequency; and

a transmit linearizer for generating a transmit calibration value in response to the automatic gain control setpoint, the second power value, and a frequency index corresponding to the second frequency, the transmit calibration value being coupled to the control input of the transmit amplifier and adjusting the gain of the transmit amplifier.

4. A radio having a transmit power calibration capability, the radio transmitting and receiving signals having a plurality of frequencies, each frequency having a frequency index, the radio transmitting a signal, having a first frequency, through a variable gain transmit amplifier having a control input and receiving a signal, having a second frequency, through a variable gain receive amplifier having a control input, the radio comprising:

a first analog to digital converter, coupled to the receive amplifier, for generating a digital signal from the received signal;

a power detector, coupled to the first analog to digital converter, for generating a power value from the digital signal;

an integrator, coupled to the power detector, for generating an automatic gain control setpoint from the power value;

a receive linearizer, coupled to the integrator, for generating a receive calibration value in response to the automatic gain control point and a first frequency index corresponding to the second frequency;

a first digital to analog converter, coupled to the receive linearizer, for generating an analog, receive calibration value from the receive calibration value, the analog calibration value coupled to the receive amplifier control input and varying the gain of the receive amplifier;

a second power detector, coupled to the transmit amplifier, for generating an analog power value from the transmitted signal;

- 24 a second analog to digital converter, coupled to the second power
detector, for generating a digital power value from the analog power
value;
- 26 a transmit linearizer, coupled to the integrator, for generating a
transmit calibration value in response to the automatic gain control
28 setpoint, the digital power value, and the frequency index corresponding
to the first frequency; and
- 30 a second digital to analog converter, coupled to the second control
input, for generating an analog, transmit calibration value from the
32 transmit calibration value, the analog, transmit calibration value
adjusting the gain of the transmit amplifier.

SUB 34

5. A method for limiting transmit power of a radio operating in
2 a radio communications system, the radio communications environment
comprising a at least one base station that transmits signals to the radio
4 including power control commands, the radio comprising a variable gain
amplifier and a maximum gain setting, the method comprising the steps
6 of:
- determining an open loop power control value in response to a
8 signal received from the at least one base station;
- determining a gain adjust signal in response to the transmit power
10 control commands;
- combining the open loop power control value and the gain adjust
12 signal to produce a summation signal;
- comparing the maximum gain setting to the summation signal;
- 14 if the summation signal is greater than or equal to the maximum
gain setting, adjusting the variable gain amplifier in response to the
16 maximum gain setting; and
- if the summation signal is less than the maximum gain setting,
18 adjusting the variable gain amplifier in response to the summation
signal.

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2. 6. The method of claim 5 and further including the step of
2 adjusting the maximum gain setting in response to a temperature of the
variable gain amplifier.

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7. The method of claim 6 wherein the step of adjusting the
2 maximum gain setting further includes the steps of:

transmitting a signal with the variable gain amplifier;
4 detecting a power value of the transmitted signal;
scaling the power value to produce a scaled power signal;
6 subtracting the maximum gain setting from the scaled power
signal to produce a difference signal; and
8 adding the difference signal to the maximum gain setting.

8. A method for limiting transmit power of a radio operating in
2 a cellular environment, the cellular environment comprising a plurality
of cells that transmit power control commands to the radio, the radio
4 comprising a variable gain amplifier and a maximum gain setting, the
method comprising the steps of:
6 determining an open loop power control value in response to a
signal received from at least one cell;
8 determining a gain adjust signal in response to the transmit power
control commands;
10 combining the open loop power control value and the gain adjust
signal to produce a summation signal;
12 adjusting the maximum gain setting in response to a temperature
of the variable gain amplifier;
14 comparing the adjusted maximum gain setting to the summation
signal;
16 if the summation signal is greater than or equal to the maximum
gain setting, prohibiting the gain adjust signal from changing in
18 response to the transmit power commands;
if the summation signal is greater than or equal to the maximum
20 gain setting, adjusting the variable gain amplifier in response to the
maximum gain setting; and
22 if the summation signal is less than the maximum gain setting,
adjusting the variable gain amplifier in response to the summation
24 signal.

9. A method for limiting transmit power of a radio operating in
2 a cellular environment, the cellular environment comprising a plurality
of cells that transmit power control commands to the radio, the radio
4 comprising a variable gain amplifier, a maximum gain setting, and a
power limiting accumulator, the method comprising the steps of:
6 transmitting a signal with the variable gain amplifier;

determining a gain adjust signal in response to the transmit power
8 control commands;
detecting a power value of the transmitted signal;
10 digitizing the power value;
comparing the digitized power value to the maximum gain setting;
12 if the digitized power value is greater than the maximum gain
setting, decreasing the gain of the variable gain amplifier; and
14 if the digitized power value is greater than the maximum gain
setting, prohibiting the gain adjust signal from changing in response to
16 the transmit power commands.

10. A method for limiting transmit power of a radio operating in
2 a cellular environment, the cellular environment comprising a plurality
of cells that transmit power control commands to the radio, the radio
4 comprising a variable gain amplifier, a maximum gain setting, and a
power control command accumulator that generates a gain adjust signal,
6 the method comprising the steps of:

transmitting a signal with the variable gain amplifier;
8 determining a gain adjust signal in response to the transmit power
control commands;
10 detecting a power value of the transmitted signal;
digitizing the power value;
12 comparing the digitized power value to the maximum gain setting;
if the digitized power value is greater than the maximum gain
14 setting, decreasing the gain adjust signal by a predetermined amount for
every predetermined unit of time until the gain adjust signal is less than
16 the maximum gain setting; and

if the digitized power value is less than or equal to the maximum
18 gain setting, varying the gain of the variable gain amplifier in response to
the gain adjust signal.

11. A method for limiting transmit power of a radio operating in
2 a cellular environment, the cellular environment comprising a plurality
of cells that transmit power control commands to the radio, the radio
4 comprising a variable gain amplifier, a maximum gain setting, and a
power limiting accumulator, the method comprising the steps of:

6 transmitting a signal with the variable gain amplifier;
determining a gain adjust signal in response to the transmit power
8 control commands;

detecting a power value of the transmitted signal;
10 digitizing the power value;
determining a difference between the digitized power value and the
12 maximum gain setting;
integrating the difference to generate a gain control signal, the gain
14 control signal being limited to a predetermined range;
adjusting the variable gain amplifier with the gain control signal;
16 if the gain control signal is less than a predetermined value,
prohibiting the gain adjust signal from changing the variable gain
18 amplifier in response to the transmit power commands.

12. A method for limiting transmit power of a radio operating in
2 a cellular environment, the cellular environment comprising a plurality
of cells that transmit power control commands to the radio, the radio
4 comprising a variable gain amplifier and a power limiting accumulator,
the method comprising the steps of:
6 receiving a signal from at least one of the plurality of cells;
determining a power value of the signal;
8 determining a closed loop power control value in response to the
signal;
10 generating a limiting gain control setting in response to the closed
loop power control value and the power value, the limiting gain control
12 signal being within a predetermined range;
combining the closed loop power control value and the power value
14 and the limiting gain control setting to generate a gain control setting;
and
16 adjusting the variable gain amplifier in response to the gain control
setting.
18